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(72) Inventor ALFRED BUFFOLI

(19)

(54) A DEVICE FOR CONTROLLING THE RELATIVE MOTIONS OF TWO STRUCTURAL MEMBERS OR COMPONENTS, PARTICULARLY IN MACHINE TOOLS

(71) We, OFFICINE MECCANICHE RINO BERARDI S.P.A., an Italian Joint-Stock Company, of 185 Via Lamarmora, Brescia, Italy, do hereby declare the invention for which we pray that a patent may be granted to us and the method by which it is performed to be particularly described in and by the following statement:—

This invention relates to a device for controlling the relative motion of structural members or components.

In an embodiment the device is employed for controlling the precision rectilinear traverses as performed in machine tools, wherein a slide is movably fitted on guides of machine bed and the slide is traversed in either direction relative to the machine bed. The purpose of the device is to control such traverses with accuracy and efficiency.

The procedures heretofore most commonly followed for the control of such traverses in machine tools are carried into practice by the so called ball recirculating devices, or by rack-pinion devices, all of which are already well known in the art, whereby a detailed description thereof is unnecessary.

It is however to be pointed out that in the case of machine tools wherein longer traverses are to be performed, the use of ball recirculating devices is inadvisable. This is due both to the high cost of such devices, to the poor degree of precision that can be attained owing to cumulative pitch errors, and especially in the case of very long screws, to linear expansion caused by temperature changes and by which not negligible error values may be attained.

A disadvantage of rack-pinion device arises from the low mechanical efficiency due to power losses caused by the friction. Such losses may be compensated by having recourse to a more powerful driving motor and to stronger transmission means, but this is obviously uneconomical. Moreover, in both cases as specified above, a dimension checking system becomes indispensable, which system usually consists of a two-turret cell with Inductosyn (a trade name for a commercially available electronic system for precision measurement of linear type, or by a three-turret cell fitted on a precision rack, which is highly intricate and expensive.

According to the present invention there is provided a device for controlling the relative motion between two structural members or components, comprising an endless screw rotatable but not axially displaceable with respect to one of said components, drive means for rotating the endless screw, a plurality of rollers rotatably mounted on the other of said components, said rollers each being adapted to engage with the thread of the endless screw for the conversion of rotary motion of the screw into relative rectilinear motion of said components, wherein said rollers are arranged in two rows, said rows being arranged to engage with diametrically opposed portions of the screw thread.

In the preferred embodiment of the invention the device controls the traversing motion of a member, such as a slide, across a bed of a machine tool. The endless screw is mounted along with associated drive means, on the slide, while the rollers are located on a stationary support of the bed extended across the whole length of slide traverse, in positions of mutual cooperation with the screw thread(s). Thus, the screw length is minimized, and a high degree of precision in performing any traverse can be attained, since the pitch error is not cumulative, and the linear expansion or contraction is negligible. The friction contact of the screw with its seat,

comprising said plurality of rollers, is a rolling friction. This enables a very high power transmission efficiency to be attained. It also permits reduction of the required driving torque even when starting transmission. Thus, it is possible to decrease the sizes of different device components, which results in large dimensional and cost savings. Finally, the preferred embodiment of the device is suitable to be fitted with a particularly advantageous — also from an economical viewpoint — dimension checking system, such as a three-turret cell, fitted on top of the endless screw.

According to an advantageous feature of previously described device, said endless screw is formed by two distinct sections, one of which is secured to a common driving shaft, while the other section is axially but not rotary movable with respect to same shaft. In such embodiment form, the device also comprises means for controlling and defining the axial position of said second screw section in respect to shaft and to first screw section, whereby to ensure that the fore thread flanks of one screw section be engaged with the rollers, whilst conversely the rear thread flanks of the other screw section are to be kept engaged with the rollers, thus ensuring a complete elimination of any backlash between screw and rollers, possibly along with a slight pre-load.

An embodiment of the invention will now be described by way of example only, with reference to the accompanying drawing, in which: —

Fig. 1 shows a plan view of the screw only and of means by which the device is driven;

Fig. 2 shows a partially sectional side view, with some components omitted for clarity, of the screw engaged with the rollers of stationary part or bed of a machine tool.

Fig. 3 shows an elevation in which the device for checking the motions of a slide on a machine tool is fitted.

In the preferred embodiment shown in the drawing the device is incorporated in a machine tool for controlling the traverses of a slide 10 thereof, with respect to a bed 12 (Fig. 3). A motor is fitted on the slide 10 to drive a short shaft 16 through a reduction gear 14 (see Fig. 1), in either direction of rotation for rotation without axial displacement. Shaft 16, which is supported by the bearings 18, 20 and 22, is short relative to the maximum traverse of the slide 10. An endless screw section 26, which extends between the bearings 18 and 20, is rigidly secured to said shaft 16 by means of a key 24. Screw section 26 comprises, as shown, a cylindrical support 28 on which there is fromed a spirally extending, single square thread 30, having a given pitch p. As previously stated, said screw section 26 is tightly fastened to said shaft 16.

A second screw section 32, similar to screw section 26 and extending between the bearings 20 and 22, is rotatably coupled to the shaft 16 by a key 34 to be axially movable relative to the shaft 16.

A support 38, which is rigidly secured to the bed 12 of the machine tool, carries a plurality of rollers 36, distributed across the whole length of the traverse to be covered by the screw sections 26-32 and the slide 10. The rollers are freely rotatable and adapted to engage into the spaces as left between two adjacent turns of thread 30. Thus when the screw is rotated by the motor engagement between the thread and the rollers converts circular motion of the screw into a rectilinear advance motion of the slide.

As shown in figure 2, the rollers 36 are arranged along two alignments or rows which are diametrically opposed with respect to screw, and are spaced in each alignment by a distance p' equal to pitch p of screw.

For taking possible backlashes and the application of a slight pre-load, means are provided in the device for defining and maintaining the axial position of screw section 32, in such a manner that the upstream flanks of the thread of screw section 32 engage the adjacent rollers, whilst conversely the downstream flanks of the thread of screw section 26 engage the adjacent rollers, possibly under said pre-load. thus, as shown in the Figure 2, the fore or upstream flanks 40 of threads 30 of screw section 32 are shown engaged with the related rollers 36*a* and 36*b* whilst the rear, or downstream flanks 42 of threads 30 and screw section 26 are shown as engaged with the related rollers 36*c* and 36*d*.

The means for positioning of screw section 32 are shown diagrammatically in figure 2. These comprise an assembly in which a rack 44 engages a pinion 46 driven by a hydraulic cylinder to impart a circular motion to a cylindrical member or bush 48. This motion causes the member 48 to be screwed, or unscrewed, respectively, along the screw thread 52 of a leading screw 50, which screw 50 is secured to body of slide 10 by an anti-torque pin. Such motion enables thrust bearings 54 and 56 to take up any backlash and to apply a pre-load if required.

Modifications of the above described specific embodiments are possible. For example, the arrangement of rollers 36 may be different along the development of spiral line as defined by the screw thread.

WHAT WE CLAIM IS:—

1. A device for controlling the relative motion between two structural members or components, comprising an endless screw rotatable but not axially displaceable with respect to one of said components, drive means for rotating the endless screw, a plurality of rollers rotatably mounted on the other of said components, said rollers each being adapted to engage with the thread of the endless screw for the conversion of rotary motion of the screw into relative rectilinear motion of said components, wherein said rollers are arranged in two rows, said rows being arranged to engage with diametrically opposed portions of the screw.

2. A device according to claim 1, wherein said screw is formed with a single square thread.

3. A device according to either Claim 1 or Claim 2, when applied for controlling the traverses of a member, such as a slide across the support or bed of a machine tool, wherein said screw and the driving means thereof are mounted on the slide, said rollers being distributed in the support across the whole length of traverse to be performed by the slide in positions such as to ensure a mutual cooperation with the thread of the screw.

4. A device according to any one of Claims 1 to 3 wherein said screw consists of two distinct sections, one section being fast with a common driving shaft, the other section being rotatably coupled to the same shaft and axially movable relative to said shaft, means being provided for controlling and defining the axial position of said second screw section relative to said shaft and said first screw section in such a manner that the threads of one screw section engage the rollers with their fore flanks and the threads of the other screw section engage the rollers with their rear flanks, to permit the take-up of any backlash and to allow for the possible application of a pre-load.

5. A device according to Claim 4, wherein said means for controlling and defining the position of the second screw section comprises a cylindrical member arranged to be controllably moved in the direction of the screw axis to vary the distance between a portion of the cylindrical member which is engaged with said second screw section, and another portion of the cylindrical member which is axially secured to the screw shaft.

6. A device according to Claim 5, wherein said second screw section is acted upon by said cylindrical member through thrust bearings.

7. A device according to Claim 5, wherein said cylindrical member is engaged with a thread of a lead screw which is secured to said movable component and rotatable by means of a rack-pinion unit.

8. A device for controlling the relative motion between two structural members or components, arranged, constructed and adapted to operate substantially as hereinbefore described with reference to Figs. 1 to 3 of the accompanying drawings.

For the Applicants:—
RAWORTH, MOSS & COOK.
Chartered Patent Agents,
36 Sydenham Road,
Croydon, Surrey, CR0 2EF.
— and —
75 Victoria Street,
Westminster,
London, S.W.1.

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1 477 821 COMPLETE SPECIFICATION
1 SHEET
This drawing is a reproduction of the Original on a reduced scale.

Fig.1

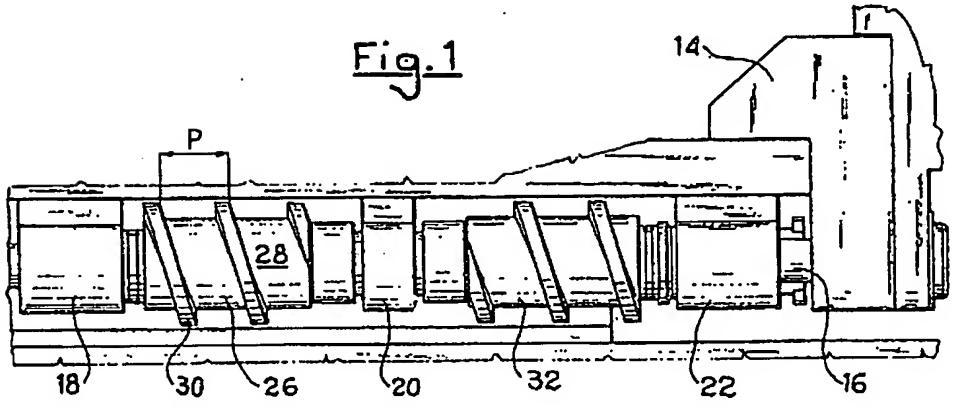


Fig.2

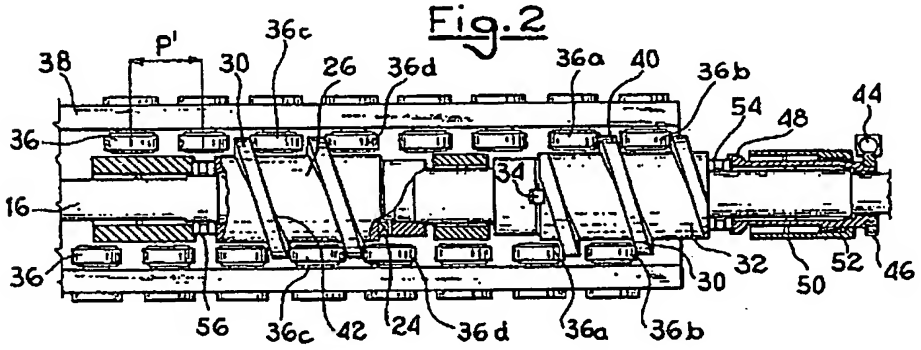
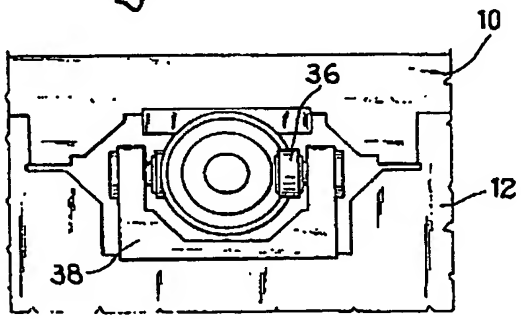


Fig.3



(translation)

NOTICE OF PRELIMINARY REJECTION

Applicant(s) : Sankyo Seisakusho Co., Ltd.

Attorney : Jong Wang Choi

Application No. : Patent Application No. 2003-74493

Title of Invention : Drive Mechanism And Movable Table Unit Provided With The Same

Notice of Preliminary Rejection is hereby given pursuant to Art. 63 of the Patent Act since this application falls under the following reason.

Any response to this Action should be submitted by November 12, 2005.

this 12th of September, 2005.

The Korea Industrial Property Office
Examining Division(Ⅱ)
Patent Examiner (Sealed)

[理由]

この 出願の 特許請求範圍 第1項 乃至 第4項に 記載された 發明は その 出願前に この 發明が 屬する 技術分野で 通常の 知識を 持つ 者が 別添 引用發明(美國 特開公報 4,898,044号)の 請求範圍 および 圖面 第1~4圖に 記載されている 驅動モータ組立體と, slide機構と、rolling運動する 螺旋形 驅動カム部材(80)と, 驅動カム部材の 溝に 連續的に 係合するようにし カムを 回轉軸線 方向へ 相對運動させる カム roller follower部材と、負荷 運搬裝置 などで 構成された 公知の linear actuator カム 驅動裝置の 技術的 構成を 採擇し 設計變更するのによって 容易に 發明できる ものですので 特許法 第29條第2項の 規定に よって 特許を 受けられない.

[添附]

添附1 美國特許公報 04898044号(1990.02.06)

발송번호: 9-5-2005-044946626
발송일자: 2005.09.12
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수신 서울시 서초구 서초3동 1545-4조방빌딩(화인특허법률사무소)
최종왕

137-872

특 허 청

의견제출통지서

출원인	명칭	가부시끼가이샤 산쿄 세이사쿠쇼 (출원인코드: 519980686452)
	주소	일본 도쿄도 기타쿠 다바타 신마 치 3-37-3
대리인	성명	최종왕
	주소	서울시 서초구 서초3동 1545-4조방빌딩(화인특허법률사무소)
출원번호		10-2003-0074493
발명의 명칭		구동 기구 및 이 구동 기구가 제공된 이동 가능한 테이블유닛

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[이유]

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[첨 부]

첨부1 미국특허공보 04898044호(1990.02.06) 1부. 끝.

2005.09.12

특허청 기계금속건설심사국
일반기계심사담당관실 심사관 김천희

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